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ABSTRACT

The study reported in this paper traces the nature of the changes which take place as the child gradually acquires perspective-taking skills. The results indicate that at first the young child can correctly represent only the location of the object nearest another observer; later, he can correctly represent a before-behind relationship between objects as seen by another observer; last, he can represent a left-right relationship between objects as seen by another observer. Nevertheless, left-right errors are still made by many 10-year-olds. Piaget and Inhelder's notion that perspective ability is fully developed by this age is too optimistic. (Author)

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THE DEVELOPMENT OF PERSPECTIVE ABILITY IN CHILDREN

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Piaget and Inhelder (1956) used the 'three mountains' task to study the development of perspective ability in young children. From a selection of pictures, each child was asked to choose first the one which corresponded with his own view of the model landscape, and then the one which corresponded with a doll's view. The doll was positioned at various points around the model.

Piaget and Inhelder concluded that the child between the ages of about 4 and 7 years is egocentric, i.e. he cannot distinguish between his own view and that of another observer. Typically, he chooses his own view and attributes it to the doll. From about the age of 7 years the child's ability to represent the doll's view correctly begins to improve: he first considers only the dominant feature of the doll's view; next he can correctly represent objects in the before-behind relationship, but he neglects left-right relationships between objects as seen from the doll's position; finally, he takes into account both the before-behind and the left-right relationships so that his response is consistently correct. This order of acquisition was also noted by Laurendeau and Pinard (1970).

The studies by Piaget and Inhelder and by Laurendeau and Pinard, however, were not specifically designed to test the order hypothesis; the conclusions were drawn largely from the children's verbal descriptions of what they thought the doll could 'see', rather than from their choice of response picture.

In a very simple task, using only one familiar object with four very distinctive sides, children as young as 4 years of age were able to determine the other observer's view (Laubengayer, 1965; Lewis and Fishbein, 1969). The dominant feature of the other view in

this case was simply the side of the object nearest to the other observer. (The task would be facilitated by the use of verbal labels such as 'front' and 'back' to identify the other's view.) Thus, relationships between objects did not have to be considered. Before the present study was conducted there was no published empirical evidence that the child first represents the dominant feature of another's view in a task in which more than one object is involved. In this experiment it was predicted that the young child who had begun to acquire perspective ability would first correctly represent the location of the object nearest the other observer since this object was considered to be the dominant feature of her view. Furthermore, it was predicted that if the child first represents another's view by correctly locating the object nearest to the other observer, then the next step would be to locate correctly the object behind the first one. In other words, the second step would be to represent correctly a relationship in the before-behind dimension as seen from the other observer's position. The correct representation of the left-right relationship would be considered last.

METHOD

Subjects

In order that only children who had begun to be able to represent another's view were retained for testing in the experimental task, 60 children were selected from each of three age groups (6, 8 and 10 years) on the basis of a criterion task. No child who scored 15/24 was retained for testing.

Materials

The child was seated at a round table; chairs were placed at the 90°, 180° and 270° positions around the table upon which a

black, circular baseboard was centrally placed.

In the practice trials the object array for both the criterion task and the experimental task consisted of four cardboard mountains, identical except for color, arranged in a diamond pattern on the baseboard.

In the test trials of both tasks, eight arrays were presented: balls, funnels, bells, skittles, cardboard candles, and three different sorts of bottles. The four objects in each array were arranged in a diamond pattern.

In the criterion task, the child selected from a set of four pictures the one which he thought matched the experimenter's view. The four pictures were: the child's own view, the 90° view, the 180° view, and the 270° view. Thus, all these pictures represented possible views of the array.

In the experimental task, the child was presented with five pictures for each position occupied by the experimenter: 1) the experimenter's view showing only the object nearest to her in its correct position (proximity-only response), 2) the experimenter's view showing only the objects in the before-behind relationship in their correct positions (left-right reversal), 3) the experimenter's view showing only the objects in the left-right relationship in their correct positions (before-behind reversal), 4) the experimenter's view with all the objects in their correct positions (correct response) and 5) the child's own view (own-view response).

Each response picture (20.5 cm. X 15.5 cm.) consisted of cut-out shapes representing the objects and the baseboard pasted onto a white background. The colors in the pictures exactly matched those of the actual objects.

Procedure

Criterion task. Each child was tested individually by the same female experimenter who also acted as the other observer.

The experimenter arranged the four mountains on the baseboard in a diamond pattern, and placed the four response pictures in two rows in front of the child. She explained that these pictures showed 'how the mountains look from different places'. The child was asked to 'choose the one that matches how you see the mountains from your place'; if he chose incorrectly, the experimenter pointed to the correct picture. Whether or not the child had been correct the experimenter explained that it matched because each mountain was in the same relative position as it appeared in the array. The child was then asked to choose the picture which corresponded with the experimenter's view: 'Which one will match how I see them from my place?' (the experimenter occupied the 90°, 180° and 270° positions in turn, but the order of these positions was randomized for each child.) Whether or not the child made the correct choice he checked his response by taking the picture to the experimenter's position. He was asked to decide for himself whether or not the picture was correct. If he could not do this the experimenter helped by encouraging him to judge if each object was in the same relative position in the picture as in the object array. If his choice was incorrect, he was asked to explain why it was wrong and to try again until he succeeded. The experimenter pointed out the spatial relationships among the mountains as seen from her own viewpoint.

In the test trials, for each of the eight arrays the child was asked first to choose among four pictures the one which matched his own view, and then the one which would match the experimenter's

view (from the 90°, 180° and 270° positions). The order of these positions, as well as the order of presentation of the arrays, was randomized; also the four response pictures were rearranged for each question.

The child was not allowed to move from his position to check his response during the test trials, and no feedback was given.

Experimental task. The procedure differed from that used in the criterion task only in that five pictures (proximity-only, left-right reversal, before-behind reversal, correct, own-view) were presented for each experimenter position.

RESULTS

Children were selected for the experimental task on the basis of their successful performance in the criterion task.

Because perspective ability is the ability to represent views different from one's own, responses to own-view questions were not scored; in fact, after the practice trial (which was also not scored) all children could correctly match a picture to their own view. Thus, in the test trials each child's maximum possible score was 24 (8 for each experimenter position). The number of responses of each type was calculated for each child. Table 1 shows the means of each type of response for the three age-levels. In all tables the following abbreviations are used: CR = correct response, Own = own-view response, P = proximity-only response, BB = before-behind reversal, and LR = left-right reversal.

Table 1 about here

The prediction for the 6-year-olds was that there would be no significant difference among correct responses, left-right reversals and proximity-only responses, but that scores for all these would be significantly higher than scores for the own-view and before-behind reversal responses. (See Table 2 for the differences among the responses at age 6 years.)

Table 2 about here

Because the data do not satisfy the criteria of normality of distribution and homogeneity of variance, non-parametric analyses were used. The tests were Friedman's two-way analysis of variance by ranks yielding a χr^2 value (Siegel, 1956, pp. 166-172) and Rosenthal and Ferguson's distribution-free comparison method (Rosenthal and Ferguson, 1965).

There was no significant difference between the correct response scores and the left-right reversals in any of the experimenter positions, but proximity-only responses were significantly lower than both of these types of responses. Proximity-only responses were, however, significantly greater than own-view responses in two of the three experimenter positions (180° and 90°), and also significantly greater than before-behind reversals in two of the three experimenter positions (90° and 270°); overall, proximity-only responses were significantly greater than own-view responses and before-behind reversals. Scores were lowest for the own-view responses and the before-behind reversals; there was no significant difference between these two types of error in any of the experimenter positions. Thus, the hypothesis regarding 6-year-olds was partially supported.

At age 8 years, it was predicted that the child would choose correct responses and left-right reversals, and that these scores would be significantly greater than the scores of the other three types of response.

This hypothesis was generally supported. (See Table 3 for the differences among the responses at age 8 years).

Table 3 about here

Although correct response scores were not significantly higher than left-right reversals for the 180° position, they were significantly higher for both the 90° and 270° positions. As predicted, both correct responses and left-right reversals were significantly greater than all other responses; and no significant differences were observed among proximity-only, before-behind reversals and own-view responses.

It was hypothesized that at age 10 years correct responses would be significantly greater than all other responses, and that no significant differences would be observed among these others. This hypothesis was also generally supported. (See Table 4 for differences among the responses at age 10 years.)

Table 4 about here

Correct responses were significantly greater than all other responses; however, left-right reversals were also significantly greater than proximity-only responses, before-behind reversals, and own-view responses (although only in the 180° position in the last instance).

In order to assess the age differences for each type of response, a Kruskal-Wallis one-way analysis of variance (Siegel, 1956, pp. 184-193) and a Dunn's test of multiple comparisons using rank sums (Dunn, 1964) were used. (See Table 5 for differences among the three age groups.)

Table 5 about here

On the whole, correct responses increased significantly with age whereas all other responses significantly decreased. The two exceptions were own-view responses and before-behind reversals: there was no significant difference between the 6- and 8-year-olds, but the scores of the 10-year-olds were significantly lower than those of the younger children.

The different positions occupied by the experimenter (90°, 180° and 270°) were compared. For most types of response there were no significant differences among the three positions, but there were significantly more correct responses for the 90° and 270° positions than for the 180° position; and at age 10 years, more left-right reversals were chosen for the 180° position than for the two side positions. (See Table 6 for differences among the positions for each type of response.)

Table 6 about here

The results provide some support for the three-step order of acqisition hypothesis. The young child represents another's view by at first considering only the object nearest the other observer. The next step in the acquistion of perspective ability is the correct location of objects in the before-behind dimension, i.e. the object nearest the other observer and the object behind it; the correct location of objects in the left-right dimension is not considered. The final step is the correct location of objects, as seen by the other observer, in both the before-behind and the left-right dimensions.

The 90^{o} and 270^{o} views were easier to represent than the 180^{o} view in terms of correct responses. There were no significant differences among the three positions for any of the different types of error, except for the predisposition of the 10-year-olds to choose more left-right reversals for the opposite position than for the two side positions. This suggests that, in the present task at least, the child employs the same strategy regardless of the experimenter's position. The relative difficulty of different viewpoints was also found by Nigl and Fishbein (1973) and is discussed more fully elsewhere by the present author (Cox, 1977).

It is interesting that even 10-year-olds had not completely phased out left-right errors. Clearly, completely successful performance in a perspectives task of this nature is quite a late development. The present results are consistent with Laurendeau and Pinard's (1970, p. 400) conclusion that perspective ability may derive from formal thought and is not fully mastered even at 12 years of age: Piaget and Inhelder's (1956) notion that perspective ability is fully developed by the age of 9 or 10 years is clearly too optimistic.

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Table 1. Mean scores of each type of response.

Response	6 years	8 years	10 years
CR	9.07	13.10	19.19
LR	7.52	5.86	3.53
P	4.35	2.12	0.28
O	2.00	1.90	0.58
BB	1.06	1.02	0.42

Table 2. Differences among the responses at age 6 years.

Comparison	Combined Positions	180°	270°	90°
	$\chi r^2 = 115.45$ 4 df, $p < .01$	$\chi r^2 = 74.68$ 4 df, $p < .01$	$\chi r^2 = 92.06$ 4 df, $p < .01$	$\chi r^2 = 111.04$ 4 df, $p < .01$
CR vs O	$< .01$	$< .01$	$< .01$	$< .01$
CR vs P	$< .01$	$< .05$	$< .01$	$< .01$
CR vs BB	$< .01$	$< .01$	$< .01$	$< .01$
CR vs LR	N.S.	N.S.	N.S.	N.S.
O vs P	$< .05$	$< .05$	N.S.	$< .05$
O vs BB	N.S.	N.S.	N.S.	N.S.
O vs LR	$< .01$	$< .01$	$< .01$	$< .01$
P vs BB	$< .05$	N.S.	$< .05$	$< .05$
P vs LR	$< .05$	$< .05$	$< .05$	$< .05$
BB vs LR	$< .01$	$< .01$	$< .01$	$< .01$

Comparison	Combined Positions	180°	270°	90°
	$\chi r^2 = 111.44$ 4 df, $p < .01$	$\chi r^2 = 73.02$ 4 df, $p < .01$	$\chi r^2 = 99.37$ 4 df, $p < .01$	$\chi r^2 = 97.34$ 4 df, $p < .01$
CR vs O	< .01	< .01	< .01	< .01
CR vs P	< .01	< .01	< .01	< .01
CR vs BB	< .01	< .01	< .01	< .01
CR vs LR	< .01	N.S.	< .01	< .01
O vs P	N.S.	N.S.	N.S.	N.S.
O vs BB	N.S.	N.S.	N.S.	N.S.
O vs LR	< .01	< .01	< .01	< .01
P vs BB	N.S.	N.S.	N.S.	N.S.
P vs LR	< .01	< .01	< .01	< .01
BB vs LR	< .01	< .01	< .01	< .01

Table 4, Differences among the responses at age 10 years.

Comparison	Combined Positions	180°	270°	90°
	$\chi r^2 = 149.71$ 4 df, $p < .01$	$\chi r^2 = 129.51$ 4 df, $p < .01$	$\chi r^2 = 119.10$ 4 df, $p < .01$	$\chi r^2 = 118.53$ 4 df, $p < .01$
CR vs O	< .01	< .01	< .01	< .01
CR vs P	< .01	< .01	< .01	< .01
CR vs BB	< .01	< .01	< .01	< .01
CR vs LR	< .01	< .01	< .01	< .01
O vs P	N.S.	N.S.	N.S.	N.S.
O vs BB	N.S.	N.S.	N.S.	N.S.
O vs LR	< .01	< .01	N.S.	N.S.
P vs BB	N.S.	N.S.	N.S.	N.S.
P vs LR	< .01	< .01	< .01	< .01
BB vs LR	< .01	< .01	< .01	< .01

Table 5. Age differences for each type of response.

Response	H	df	6 yrs. vs 8 yrs.	6 yrs. vs 10 yrs.	8 yrs. vs 10 yrs.
CR	82.06	2	$<.01$	$<.01$	$<.01$
LR	45.95	2	$<.01$	$<.01$	$<.01$
P	61.53	2	$<.01$	$<.01$	$<.01$
O	30.05	2	N.S.	$<.01$	$<.01$
BB	20.61	2	N.S.	$<.01$	$<.01$

Table 6. Differences among the experimenter positions for each type of response.

Response	Age	χr^2	df	p	180° vs 270°	180° vs 90°	90° vs 270°
CR	6	12.18	2	$<.01$	$<.05$	$<.01$	N.S.
CR	8	13.30	2	$<.01$	$<.05$	$<.01$	N.S.
CR	10	26.69	2	$<.01$	$<.01$	$<.01$	N.S.
O	6	2.92	2	N.S.			
O	8	1.67	2	N.S.			
O	10	0.23	2	N.S.			
P	6	3.11	2	N.S.			
P	8	2.03	2	N.S.			
P	10	0.17	2	N.S.			
BB	6	3.73	2	N.S.			
BB	8	1.46	2	N.S.			
BB	10	1.67	2	N.S.			
LR	6	5.83	2	N.S.			
LR	8	3.77	2	N.S.			
LR	10	24.16	2	$<.01$	$<.01$	$<.01$	N.S.

Abstract

The study reported in this paper traced the nature of the changes which take place as the child gradually acquires perspective-taking skills. The results indicate that at first the young child can correctly represent only the location of the object nearest another observer; later, he can correctly represent a before-behind relationship between objects as seen by another observer; last, he can represent a left-right relationship between objects as seen by another observer. Nevertheless, left-right errors are still made by many 10-year-olds; Piaget and Inhelder's notion that perspective ability is fully developed by this age is too optimistic.